BULLETIN OF MARINE SCIENCE, 42(2): 246–252, 1988

THOMPSONIA LUETZENI, NEW SPECIES (CIRRIPEDIA: RHIZOCEPHALA), A SOLITARY PARASITE FROM THE ALPHEID SHRIMP *ALPHEUS PARVIROSTRIS*

J. T. Høeg and A. J. Bruce

ABSTRACT

A new rhizocephalan barnacle, *Thompsonia lützeni* Høeg and Bruce, is described from the alpheid shrimp *Alpheus parvirostris* Dana. Unlike all previously described species of *Thompsonia* which are highly gregarious, *T. lützeni* is unique in being solitary on its host. *T. lützeni* is the largest *Thompsonia* species yet described and differs from other species in some anatomical details.

Members of the genus *Thompsonia* deviate considerably from most other species of the Rhizocephala, and their systematic position is uncertain. They parasitize a variety of hosts among the Brachyura, the Anomura, and alpheid shrimps. Hence *Thompsonia* has the widest taxonomical host range of any rhizocephalan genus. All species of *Thompsonia* described so far have been gregarious, and often several hundred individual externae parasitize a single host. Potts (1915) showed that the individual reproductive bodies (externae) are mutually connected by a common root system within the host. The size of the *Thompsonia* externa is usually very small in relation to the size of the host, most possibly a consequence of the obligatory multiple externae. The anatomy of the externa is very simple, since it lacks a mantle aperture, a mantle cavity, and true male cell receptacles (Reinhard and Stewart, 1956; Yanagimachi and Fujimaki, 1967). The larvae of *Thompsonia* hatch in the cypris stage, which is very small (<100 μm). This paper describes a new species of *Thompsonia,* which is unique in being very large and solitary on its alpheid host.

Thompsonia luetzeni new species

Holotype.—Zanpa-Misaki, Okinawa, Ryukyu Islands, 26°26'N., 127°43'E., October 24, 1984; one externa on *Alpheus parvirostris* Dana, from colonies of *Galaxea fascicularis* L. Deposited in the Northern Territory Museum of Arts and Sciences, Darwin, N.T., Australia.

Paratype.—One externa on *Alpheus parvirostris* Dana. The externa removed from the host, embedded in Epon, sectioned at 2 μm in semilongitudinal sections, and stained with Toluidine Blue. Paratype host and section series deposited with the holotype.

Etymology.—The species is named after Dr. J. Lützen, Institute of Cell Biology and Anatomy, University of Copenhagen, in acknowledgment of his contributions to invertebrate parasitology.

Definition.—Mature externa solitary and very large (2–4 mm long, excluding) stalk. A large, epithelium lined lacuna with no communication to the exterior, situated between the ovary and the external cuticle.

Description.—The host of the holotype is 4.9 mm long excluding chelipeds; its large, right cheliped is 3.0 mm long. The host of the paratype is 11.0 mm long excluding chelipeds; its right cheliped (detached from body) measures 7.1 mm. Both hosts carried only a single parasite externa. The holotype is attached on the

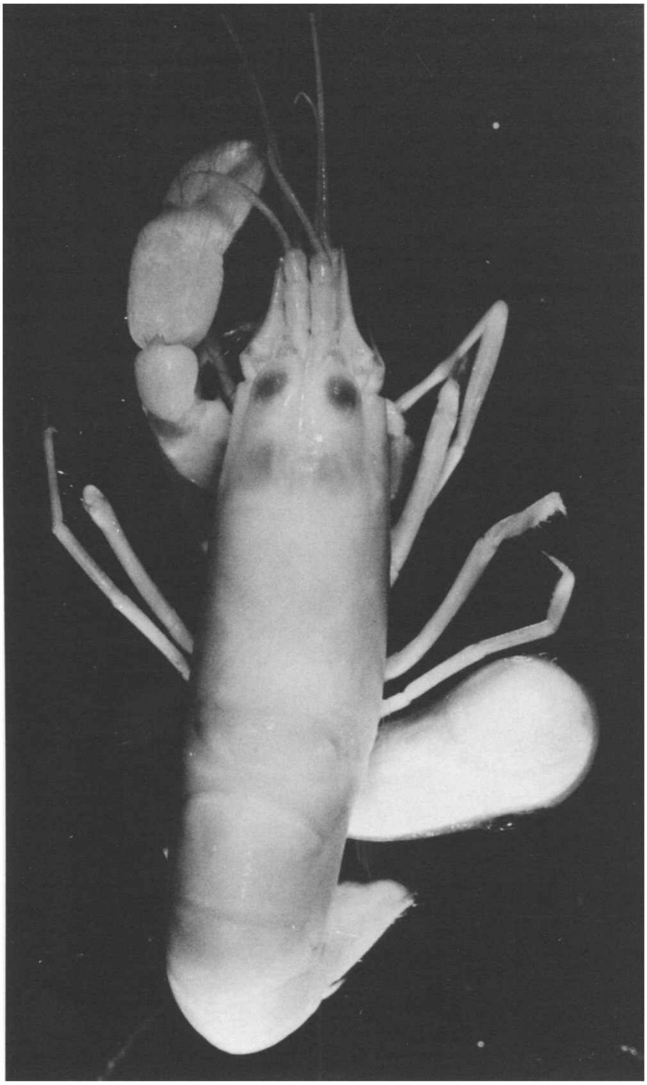

Figure 1. *Thompsonia luetzeni*, n. sp., paratype, on *Alpheus parvirostris* Dana (dorsal view). The large, right cheliped is detached from the shrimp.

right side of the sternite of the 1st pleomere. The paratype was attached in the midline of the sternite of the 1st pleomere.

The externa is an ovoid pearshaped body, tapering towards the stalk end. The externa body itself is rather distinctly set off from the narrow stalk which is ~⅓ the length of the body (Figs. 1, 2). The length of the holotype (excl. stalk) is 2.1 mm, and of the paratype (excl. stalk) 4.2 mm. Just before the insertion into the host the stalk becomes extremely narrow (Fig. 2B). There are no prominent cuticular rings around the stalk as observed in some other species of *Thompsonia* (Häfele, 1911). The color of the preserved externa is orange-yellow owing to the developing embryos filling both holotype and paratype.

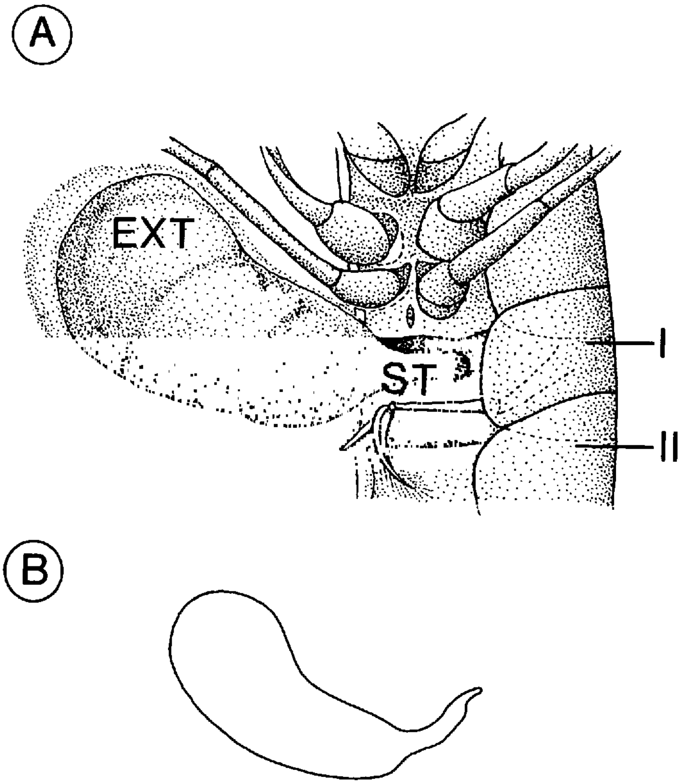

Figure 2. A: Insertion of the paratype of *Thompsonia luetzeni* on the sternite of the 1st pleomere of *Alpheus parvirostris* Dana (Ventral view). B: Schematic figure of shape of externa and stalk. EXT, externa; I, 1st pleomere; II, 2nd pleomere; ST, stalk.

The externae of both specimens were oriented with the externa at right angles to the long axis of the shrimp, so the externa projects a considerable distance from the right side of the host (Fig. 1).

No birth pore (mantle aperture) was visible on the surface of the externae, nor could such a structure or its anlage be seen on the sections. A few dark lines faintly visible beneath the external cuticle correspond to septae of connective tissue dividing the large ovary into 3–4 lobes (Fig. 3). The externa cuticle is 30–40 μm thick on the body, and $\sim$100 μm thick in the stalk. The cuticle is layered, but there is no evidence of any moult activity.

The very poor fixation (ethanol?) of the paratype allows only a general survey of the anatomy. The stalk is hollow, with no epithelia but containing a few scattered cells. The large ovary fills most of the externa. Ovarian tissue has degenerated and mantle tissue (epithelia) is inconspicuous or absent, so the embryos in the ovary lie directly beneath the external cuticle with no intervening epidermis. Such degeneration of mantle and ovarian tissues is also seen in other species of *Thompsonia,* and is possible because the externa produces only a single brood. The ovaries of both specimens contained developing embryos, in which the pigmentation of the nauplius eye was not (yet?) visible. In the paratype the embryos had developed (thoracic?) limb buds.

Unlike other rhizocephalans, the embryos were not surrounded by an acellular

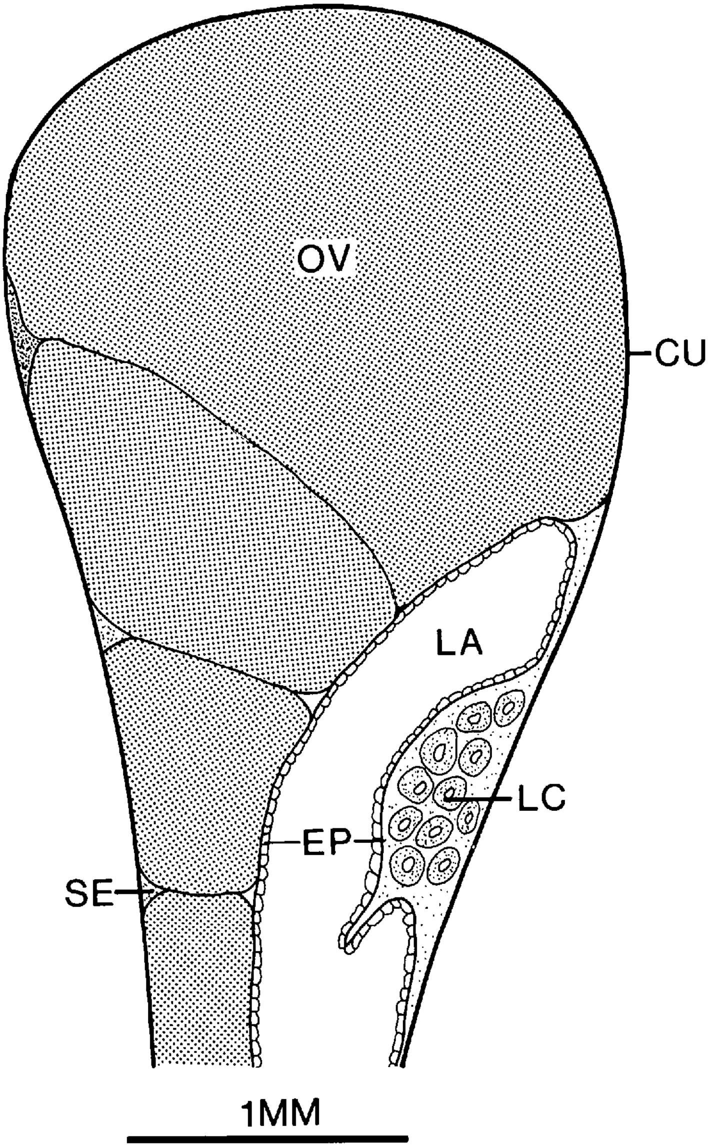

Figure 3. Diagram of the anatomy of the *Thompsonia luetzeni* externa (longitudinal section through the apical part of the paratype externa, drawn from section). CU, cuticle; EP, epitheloid cells; LA, lacuna; LC, large cells; OV, ovary with developing embryos; SE, septum dividing ovary into lobes.

capsule. The embryos of the holotype seemed to have advanced to about the same stage as the paratype.

A large lacuna lined with highly vacuolarized, epitheloid cells stretches along one side of the externa between the ovary and the external cuticle (Fig. 3). The lumen of the lacuna was devoid of cells and apparently does not communicate with the exterior or the ovary. A group of numerous large cells (diam. ≤ 150 μm) with large nuclei (diam. ≤ 65 μm) was situated between this this lacuna and the external cuticle.

Discussion.—In external form the present parasites resemble the rhizocephalan genus *Thompsonia* Kossmann 1874 and are relegated to this genus based on the following similarities. A true mantle cavity is absent and the eggs develop directly in the ovary. The mantle tissue surrounding the ovary tend to disintegrate when embryogenesis advances. There is no male cell receptacle comparable to those found in the Kentrogonida (Peltogastridae, Lernaeodiscidae, Sacculinidae) and the Clistosaccidae.

The only other rhizocephalan, which in external shape resembles *Thompsonia* is *Pirosaccus socialis* (Lützen, 1985). However, *Pirosaccus* differs from *Thompsonia* by having a real epithelium- and cuticle-lined mantle cavity, where fertilization and embryonic development take place. Moreover, in *Pirosaccus* spermiogenesis takes place in single layered cellular capsules lying freely in the mantle cavity. This is reminiscent of the condition found in the Chthamalophilidae and related species (Bocquet-Védrine and Bourdon, 1984). Such capsules are not found in *Thompsonia luetzeni* and it is unknown where spermiogenesis takes place.

Table 1 lists the species of *Thompsonia* previously recorded from alpheid shrimps. The descriptions of Coutiere (1902a,b,c,d) are wanting in not being accompanied by figures or an account of the internal anatomy of the parasites. Nevertheless, Coutiere relegated his parasites to the new genus *Thylacoplectus,* but as rightly pointed out by Potts (1915), they do not deviate enough from other *Thompsonia* species to warrant rank as a separate genus. Potts himself collected a number of *Thompsonia* from alpheids, but refrained from describing them to species level. The parasites seen by Potts (1915) and those illustrated by Bate (1888) are attached to the pleopods of the host, while Coutiere's specimens and *T. luetzeni* are attached on the abdominal sternites. But unlike *T. lützeni,* Coutiere's parasites are all highly gregarious and have small externa sizes just like those seen by Potts and Bate. Thus *Thompsonia luetzeni* is separated from all specimens previously recorded from alpheid shrimps in being strictly solitary and in having a very large externa size. Both in absolute terms and in relation to host size *T. luetzeni* is by far the largest species of *Thompsonia* yet described, including those from anomuran or brachyuran hosts. The statement that *T. luetzeni* is solitary is so far based only on two specimens, but it is unlikely that more than a single *T. luetzeni* externa could parasitize a host without impeding its movements seriously (Fig. 1). Moreover, Kampen and Boschma (1925) reported on an *Alpheus malleodigitatus* hosting a single *Thompsonia* externa of roundish shape and attached to the sternite of the fourth pleomere. This specimen was most likely a juvenile *T. luetzeni.*

In the monograph by Potts (1915) *Thompsonia* was reported to be parthenogenetic, since he could not find a testis in the externa. Reinhard and Stewart (1956) located a presumed testis in the mantle of *T. cubensis* and concluded that it was a self-fertilizing hermaphrodite. However, Yanagimachi and Fujimaki (1967) argued that *Thompsonia* has separate sexes and that the spermatogonia originate from male cyprids as in more conventional rhizocephalans (Høeg and Lützen, 1985). They presented strong, indirect evidence that in the absence of a mantle aperture, the male cells of *T. japonica* are implanted directly though the cuticle of the young externa. Recently Høeg (1985) demonstrated this very form of male cell implantation in another aberrant rhizocephalan, *Clistosaccus paguri.* Yanagimachi and Fujimaki (1967) showed that after implantation, spermiogenesis proceeds in one or two "centers" in the mantle tissue among some very large, female nurse cells—the "testis" of Reinhard and Stewart. These centers have no epithelial delimitation nor do they communicate with a true mantle cavity as the male cell receptacles of the Clistosaccidae and the Kentrogonida (Høeg and Lützen, 1985).

Table 1. *Thompsonia* from alpheid shrimps

Species	Reference	Host species	Parasites/host (No.)	Parasite attachment
Thompsonia edwardsii	Coutiere (1902a, b, c, d)	*Alpheus edwardsii* (Audouin)	ca. 100	abdominal sternites
Thompsonia haddoni	—	*Alpheus avarus* (Fabricius)[1]	ca. 100	abdominal sternites
"*Thompsonia heurteli*"[2]	—	*Alpheus macrochirus* (Richters)[3]	ca. 100	abdominal sternites
Thompsonia sp.	Bate (1888)[4]	*Alpheus malleodigitatus* (Bate)	ca. 100	pleopods
Thompsonia sp.	Potts (1915)	"*Synalpheus brucei*"	ca. 100	pleopods
Thompsonia sp.[5]	Kampen and Boschma (1925)	*Alpheus malleodigitatus* (Bate)	1	abdominal sternites
Thompsonia luetzeni	Present paper	*Alpheus parvirostris* Dana	1	abdominal sternites

[1] Probably a synonym for *Alpheus strenuus* Dana; see Banner and Banner (1982).
[2] Not formally erected as species by Coutiere, but incorrectly listed as "*Thompsonia heurteli*" by Potts (1915).
[3] A synonym for *Alpheus sulcatus* Kingsley; see Banner and Banner (1982).
[4] Bate (1888: pp. 565–566 and plate 101).
[5] Probably a juvenile *T. luetzeni*.

Thompsonia luetzeni differs from all hitherto described species of *Thompsonia* (syn. *Thylacoplectus*) by the presence of the epithelium-lined lacuna in the externa. The nature of this lacuna is obscure, since no cells were seen in the lumen and no pore or canal connected it with the exterior or the ovary. Even after sperm release at least a few of the characteristic filiform cirripede spermatozoa would expectedly be found within a male cell receptacle or a testis. The large cells interspaced between the lacuna and the cuticle could be homologous to the large nurse cells seen in *T. japonica,* but no spermiogenesis or spermatozoa were seen between them or anywhere else in the externa of *T. luetzeni.* Another possibility is that the large cells are unfertilized ova.

The anatomical peculiarities of *T. luetzeni* may warrant its elevation to a higher taxonomic rank. However, following the advice of Potts (1915), this should only be done in connection with a major revision of the genus *Thompsonia.* Such a study requires new and well-preserved collections and re-investigation of the origin of the male cells in *Thompsonia* and other aberrant rhizocephalans.

ACKNOWLEDGMENTS

Dr. H. Yamashiro is acknowledged for the collection of the holotype of *Thompsonia luetzeni.* We are very grateful to the late Professor A. H. Banner and to Mrs. D. M. Banner (Hawaii Institute of Marine Biology) for identification of the host of the paratype and valuable information on the taxonomy of alpheid shrimps. The financial support of the Carlsberg Foundation (to J.H.) is gratefully acknowledged.

LITERATURE CITED

Banner, A. H. and D. M. Banner 1982. The alpheid shrimps of Australia. Part III: The remaining alpheids, principally the genus *Alpheus,* and the family Ogyrididae. Recds. Austr. Mus. 34(1–2).

Bate, S. 1888. Report on the Crustacea Macrura dredged by H.M.S. Challenger during the years 1873–1876. Challenger Reports, Zoology XXIV.

Bocquet-Védrine, J. and R. Bourdon. 1984. *Cryptogaster cumacei,* n. sp., premier rhizocéphale parasite d'un cumacé. Crustaceana 46: 261–270.

Coutiere, H., 1902a. Sur un nouveau type de Rhizocéphale, parasite des Alpheidae. C. R. Séanc. Soc. Biol. 54: 447–449.

———. 1902b. Sur un nouveau type de Rhizocéphale grégaires parasite des Alpheidae (Deuxième note). C. R. Séanc. Soc. Biol. 54: 625–626.

———. 1902c. Sur un nouveau type de Rhizocéphale grégaires parasite des Alpheidae (Troisième note). C. R. Séanc. Soc. Biol. 54: 724–725.

———. 1902d. Sur un nouveau type de Rhizocéphale, parasite des Alpheidae. C. R. Hebd. Séanc. Acad. Sci., Paris. 134: 913–915.

Häfele, F. 1911. Notitzen über phylogenetisch interessanten Rhizocephalan. Zool. Anz. Leipzig 38: 180–185.

Høeg, J. T. 1985. Male cypris settlement in *Clistosaccus paguri* Lilljeborg (Crustacea: Cirripedia: Rhizocephala). J. Exp. Mar. Biol. Ecol. 89: 221–235.

——— and J. Lützen. 1985. Rhizocephala. Marine Invertebrates of Scandinavia. No. 6. Norwegian University Press, Oslo. 92 pp.

Kampen, P. N. van and H. Boschma. 1925. Die Rhizocephalfen der Siboga Expedition. Siboga-Exped. Uitkom. Zool. Nederl. Oost-Indie (1889–1900). Monograph XXXI. 67 pp.

Kossmann, R. 1874. Beiträge zur Anatomie schmarotzenden Rankenfüssler. Arb. Zool. Inst. Würzb. 1: 97–137.

Lützen, J. 1985. Rhizocephala (Crustacea: Cirripedia) from the deep sea. Galathea Report 16: 99–114, pl 14.

Potts, F. A. 1915. On the rhizocephalan genus *Thompsonia* and its relation to the evolution of the group. Publ. Carnegie. Inst. 212(8): 1–32.

Reinhard, E. G. and T. Stewart. 1956. The hermaphroditic nature of *Thompsonia* (Crustacea: Rhizocephala) with description of *Thompsonia cubensis*, n. sp. Proc. Helminth. Soc. Wash. 23: 162–168.

Yanagimachi, R. and N. Fujimaki. 1967. Studies on the sexual nature of the Rhizocephala. IV. On the nature of the "testis" of *Thompsonia*. Annot. Zool. Jap. 40: 98–104.

DATE ACCEPTED: May 20, 1987.

ADDRESSES: *(J.T.H.) Institute of Cell Biology and Anatomy, The Zoological Institutes, University of Copenhagen, 15 Universitetsparken DK-2100 Copenhagen Denmark; (A.J.B.) Northern Territory Museum of Arts and Sciences, Bullocky Point, Fannie Bay, N.T., G.P.O. Box 4646, Darwin, N.T. 5794, Australia.*